THE MINERAL INDUSTRY OF MALI

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Mali, which is located in West Africa, is a landlocked country bordered by Algeria, Burkina Faso, Cote d'Ivoire, Guinea, Mauritania, Niger, and Senegal. In 2003, population was estimated to be about 11.6 million. The country's total land and water area is 1.24 million square kilometers (km^2), which is slightly less than twice the size of the State of Texas (U.S. Central Intelligence Agency, 2003§;[1] International Monetary Fund, 2004b§). According to World Bank (2004b§) reports, Mali's real gross domestic product (GDP) growth has averaged about 5% per year since 1994; this growth has enabled real per capita GDP, which was estimated to be $290 in 2003, to rise by about 2.5% per year. GDP based on purchasing power parity was estimated to be $10.1 billion (International Monetary Fund, 2004b§). The World Bank (2004b§) attributed the country's favorable economic performance to the reestablishment of political and social stability and to the effective implementation of macroeconomic stabilization and economic liberalization policies, which included the implementation of a privatization program.

Mali's mineral sector was dominated by gold mining. Gold has become Mali's leading export product followed by cotton. Gold exports, which accounted for about 57% of the country's total exports, were valued at $542 million in 2003. Mali was Africa's third leading gold producer following South Africa and Ghana. Other mineral commodities produced in the country included diamond, gypsum, phosphate rock, and salt (International Monetary Fund, 2004b§, World Bank 2004a§).

The Government agency responsible for the mining sector in Mali was the National Directorate for Geology and Mines, which was part of the Ministry of Mines, Energy and Water Resources. In 2003, the Government was in the process of revising the Mining Code for the second time since the establishment of the Code in 1991 (Organisation for Economic Co-operation and Development, 2004, p. 197).

Mineral exploration efforts were focused on base metals, bauxite, iron ore, and phosphate rock. The Tessalit deposit, which is located in the Adrar des Iforas area in eastern Mali, had estimated resources of about 1 million metric tons (Mt) that contained 13% zinc, 2% copper, 30 grams per metric ton (g/t) silver, and less than 1 g/t gold. Iron ore resources in the Bale area were estimated to be 146 Mt at a grade of 50% iron [Mbendi Information Services (Pty.) Ltd., 2004§].

Although several old and new mines were expected to come into production during the next 3 years, the mining sector was still underdeveloped owing, in part, to the lack of appropriate infrastructure to support mining activities. Institutional reforms to improve the country's infrastructure, however, were underway. Among them was a mineral development program to simplify the procedure for opening small mines, provide easier access to funding, and facilitate partnerships with foreign firms (Organisation for Economic Co-operation and Development, 2004, p. 197-198). Other projects included the creation of the National Office of Roads and the Office of Road Data, implementation of a study on the country's road network classification, and establishment of the Road Authority to oversee the privatization of road maintenance (International Monetary Fund, 2004a§, p. 21).

Diamond was recovered by artisanal gold miners in the Kenieba area. Small-scale phosphate mining took place in the Tilemsi Valley in the southeastern part of the country where resources were estimated to be about 10 Mt at a grade of 31.4% P_2O_5. Iron ore resources in Bale were estimated to be 146 Mt at a grade of 50% iron [Mbendi Information Services (Pty.) Ltd., 2004§].

Gold production in Mali was primarily from the Morila, Sadiola Hill, and Yatela Mines, although some gold [about 2,000 kilograms per year (kg/yr)] was also produced by artisanal methods. In 2003, the three mines produced a total of 45,535 kilograms (kg) of gold (table 1).

The Morila open pit gold mine, which opened in 2001, was located about 180 kilometers (km) southeast of Bamako. Approximately 24,700 kg of gold was produced during 2003. The mine was owned by Morila S.A., [a subsidiary of Morila Limited of Mali (80%) and the Government of Mali (20%)]. Morila Limited was a 50-50 joint venture between AngloGold Ltd. of South Africa and Randgold Resources Ltd. of the United Kingdom. Total indicated, inferred, and measured resources at Morila were reported to be 32.62 Mt at a grade of 3.64 g/t gold or about 118,504 kg of contained gold (reported as 3.81 million ounces). Randgold Resources planned to expand its metallurgical plant to increase throughput from 250,000 to 350,000 metric tons per month to process lower grade ore. The new facilities were expected to come onstream during the first quarter of 2004 (Randgold Resources Ltd., 2004, p. 17-20).

The Sadiola Hill open pit gold mine was located about 80 km southwest of Kayes. The mine, which produced about 14,000 kg of gold in 2003, was owned by La Société d'Éxploitation des Mines d'Or de Sadiola S.A. (Sadiola) [a joint venture of AngloGold Ltd. of South Africa (38%), IAMGOLD Corp. of Canada (38%), the Government of Mali (18%), and the World Bank's International Finance Corp. (6%)] (IAMGOLD Corp., 2004, p. 8). AngloGold was the mine operator. Total measured and indicated resources at Sadiola were reported to be 43.7 Mt at a grade of 2.2 g/t gold or about 98,500 kg of contained gold (reported as 3.166 million troy ounces). Total inferred resources were reported to be 144.3 Mt at a grade of 1.8 g/t gold or about 253,000 kg of contained gold (reported as 8.137 million ounces) (IAMGOLD Corp., 2004, p. 48).

The Yatela open pit mine, which opened in 2001, was located about 60 km southwest of Kayes and 25 km north of Sadiola Hill. In 2003, Yatela produced about 6,700 kg of gold. The mine was owned by La Société d'Éxploitation des Mines d'Or de Yatela S.A. (Yatela) [a joint venture of AngloGold (40%), IAMGOLD Corp. (40%), and the Government of Mali (20%)]. AngloGold was the mine operator. Total measured and indicated resources at Yatela were reported to be 19.2 Mt at a grade of 2.3 g/t gold or about

[1]References that include a section mark (§) are found in the Internet References Cited section.

44,000 kg of contained gold (reported as 1.416 million troy ounces). Total inferred resources were reported to be 4.4 Mt at a grade of 1.0 g/t gold or about 4,540 kg of contained gold (reported as 146,000 troy ounces) (IAMGOLD Corp., 2004, p. 48).

Most of Mali's historical gold production was from placers in the Niger River and its tributaries. Mali's bedrock geology is dominated to the south by greenstone belt rocks from the Birimian craton, to the west by late Precambrian sedimentary rocks, and to the northeast by Paleozoic basinal rocks accreted to the Birimian craton. Lateritic soils cover most of the low-relief geography of the country (Geological Society of Nevada, 2002, p. 8). The principal auriferous deposits occur in two main zones or districts: the western Bambouk auriferous district that hosts the Loulo, Medinandi, Sadiola, Segala , Tabakoto, and Yatela deposits; and the southern auriferous district of Boure that hosts the Bagoe, Kangaba, Morila, Syama, and Yanfolila deposits (Keita, 2001, p. 7-8).

At least 15 companies explored for gold in Mali during 2003. Afcan Mali S.A. (a subsidiary of Afcan Mining Corp. of Canada) held the Kalako and Loubougoulou gold exploration permits. The Kalako permit was granted to Afcan Mining in December 2002. The permit was valid for 3 years and included 37 km^2 in the Yanfolila area of the Sikasso region of southern Mali. Previous work at Kalako was done by the Société Miniére de Kalako, Rochat and Associés (Afcan Mining Corp., 2002). In January 2003, Afcan signed a Heads of Agreement for the Kalako permit with Ashanti Goldfields Co. Ltd. of Ghana. Ashanti was to invest $1 million to acquire a 70% interest in the property. Upon completion of a bankable feasibility study, the company would have the option to acquire an additional 15% interest in the project. Ashanti was required to spend $15,000 within the first 6 months of signing the agreement, after which the company would have the option to withdraw at any time. Ashanti withdrew from the project in July 2003 and Afcan began seeking for a new partner to develop the property (Afcan Mining Corp., 2003§).

African Metals Corporation (AMC) of Canada held the 27 km^2-Kofeba concession, which was located within the company's Kenieba Sud diamond concession in western Mali. In 2003, the company planned to begin a preliminary exploration program that included geologic mapping, soil sampling, and pitting (African Metals Corporation, 2003b§).

In September 2002, AfriOre International Limited (a subsidiary of AfriOre Limited) signed a joint-venture agreement with New Gold Mali SA (NGM) (a subsidiary of Maurel & Prom of France) for a 60% interest in the Banankoro gold project The project, which was located near Kangaba in southern Mali, comprised an area of 144 km^2. Under the agreement, AfriOre was required to invest $2.5 million within 4 years or complete a bankable feasibility study. AfriOre was planning to begin a 2,500-meter (m) drilling program in December 2003 (AfriOre Limited, 2004§).

Avnel Gold Ltd. of the United Kingdom (80%) and the Government of Mali (20%) were redeveloping the Kalana underground mine, which was located about 300 km south of Bamako. The mine was originally built in 1985 and, at its peak, had produced 500 kg/yr of gold; the mine was closed in 1991. The mine's indicated and inferred resources were reported to be 2.9 Mt at a grade of 10 g/t gold. Reconstruction work began at the gold plant in April. The plant was expected to be commissioned at the end of November at a feed rate of about 5,000 metric tons per month (Mining Review Africa, 2003).

In September 2003, Axmin Inc. of Canada entered into a joint-venture agreement with Newmont Mining Corporation under which Newmont had an opportunity to acquire a 50% interest in Axmin's Kofi project at a cost of $5.5 million. The Kofi project included the Kofi, Kofi North, Netekoto, and Walia properties, which are located in the Kenieba district in western Mali (Axmin Inc., 2004, p. 8).

Etruscan Resources Inc. of Canada held four exploration permits in Mali, namely Djelimangara, Finkolo, Kolomba, and Sanoukou. The Djelimangara property covered an area of 220 km^2 and is located south of the Sadiola Hill Mine. The Kolomba property covered an area of 150 km^2 and is located to the southwest of Djelimangara. The Sanoukou property covered an area of 100 km^2 and is located about 15 km southwest of the Segala and Tabakoto gold deposits. Finkolo covered an area of 319 km^2 and is located about 15 km southwest of the Syama gold mine. In May, the company announced that it had begun a drilling program to test new targets at Finkolo; 2,500 m of drilling was planned. Etruscan had the option to acquire 100% interest in the Finkolo property from Bagoe National Corporation SARL by making cash payments that would total $350,000 and investing an additional $200,000 on exploration by July 18, 2004 (Etruscan Resources Inc., 2003a, b).

Golden Star Resources Ltd. (GSR) of the United States entered into a joint-venture agreement with Geo Services International Ltd. (GSI) of the United Kingdom to conduct exploration on the Mininko gold property in southern Mali. The Mininko property is located about 250 km southeast of Bamako and covered an area of 250 km^2. GSR was to acquire a 51% interest in Mininko by investing $2.6 million in exploration. The company had the option to increase its interest to 82.5% by sole funding the development of the project upon approval of the Malian Government and the consent of GSI (Golden Star Resources Ltd., 2003).

Great Quest Metals Ltd. (GQM), which had concentrated on acquiring options on concessions and performing preliminary exploration in Mali since 1998, continued with its exploration programs in 2003. The company had a total of 14 concessions that made up an area of 411 km^2. During the first phase of GQM's exploration campaign, 10 drill targets were established on the Bourdala, Baroya, and Kenieba concessions through the completion of geologic mapping, soil sampling, and pitting. During phase 2 of the exploration campaign, a diamond drilling program of 923 m was completed on the Bourdala concession; results confirmed significant gold mineralization in five of the holes drilled, which the company estimated to represent four, and possibly five, separate zones. A 726-m drilling program was completed in the Baroya and Kenieba concessions during 2003, together with soil sampling and geologic mapping of the Kenieba concession. Three of the five holes drilled at Baroya and Kenieba showed a significant intersection of gold mineralization. These sites included the Segala Extension and Baroya Nord zones in the Baroya concession, and the Djambaye 1 dyke in the Kenieba concession. At yearend, the company began a 2,000-m drilling program to follow up on the results obtained in 2002. The company planned to continue geologic mapping and soil sampling on the Niaragui, Niaragui Nord, and Soumala concessions and drilling at Bourdala (Great Quest Metals Ltd., 2003§).

In March, IAMGOLD Corp. announced the completion of exploration drilling that targeted the sulfide zone of the Sadiola deposit. The company was interested in testing the viability of substantially deepening the Sadiola oxide open pit beyond its planned depth of 150 m. The results confirmed the location and grades of the previously interpreted mineralization. The company planned to continue exploration for oxide mineralization in satellite deposits around Sadiola (IAMGOLD Corp., 2003, p. 1-3).

In August, Nevsun Resources Ltd. announced the results of a mineral reserve estimate for the Segala deposit that was performed by Snowden Mining Industry Consultants. The study concluded that proven and probable gold reserves were estimated to be 331,000 t at a grade of 2.38 g/t gold based on a price of $350 per troy ounce. The combined Segala and Tabakoto reserves were estimated to be more than 29,000 kg (reported as 950,000 troy ounces). Based on the results of the study, the company expected to extend the surface mine life of Tabakoto by up to 10 years (Nevsun Resources Ltd., 2003).

North Atlantic Nickel Corp. of Canada, through its wholly owned Malian subsidiary North Atlantic Resources Ltd., had five gold projects in Mali: the Dalakan, Diokeba, and Sinzeni gold projects, which were acquired in 2002, and the Foulalaba and Kantela projects, which were acquired in 2003. Dalakan is located in southern Mali about 240 km southeast of Bamako and 25 km southeast of the Kalana Mine. At Dalakan, soil and termite-mound sampling were completed during the year. The company planned to complete from 3,000 to 4,000 m of reverse-circulation drilling in 2004. Diokeba is located in western Mali about 500 km northwest of Bamako and 25 km southeast of the Sadiola Mine. In 2003, the company completed 3,100 of reverse-circulation drilling at the property and planned to complete an additional 3,000 to 4,000 m in 2004. Sinzeni is located in southern Mali about 210 km from Bamako and 50 km from the Morila Mine. Soil and termite-mound sampling were also completed at Sinzeni during the year. In addition, the company planned to complete high-resolution airborne multisensor surveys at all five properties in 2004 (North Atlantic Nickel Corp., 2004, p. 2-6). The Kantela property is located in western Mali about 500 km west of Bamako and 10 km southeast of the Sadiola Mine. North Atlantic had the option to acquire 100% interest in the property. In 2003, the company completed 5,700 m of exploratory drilling. Three gold-bearing zones were identified on the property. The Foulalaba property is located in southern Mali near the Ivorian border and covered an area of 185 km^2. In December, North Atlantic completed 1,261 m of reverse-circulation drilling. The future exploration and development programs for each of the properties included the acquisition of detailed airborne geophysical data, infill soil sampling and trenching, and additional drilling at an estimated cost of $350,000 for Kantela, $300,000 for Foulalaba, $250,000 for Dalakan, $200,000 for Diokeba, and $100,000 for Sinzeni (North Atlantic Nickel Corp., 2004, p. 7-10).

Randgold Resources and the Government of Mali, through Société des Mines de Loulo (SOMILO), held an 80% and 20% interest, respectively, in the Loulo gold mine project. Loulo is located near the Faleme River about 350 km west of Bamako and 220 km south of Kayes, and about 96 km from the Sadiola Mine. It contained two major deposits, Loulo 0 and Yalea. Loulo 0 was discovered in 1981 and exploration activities continued until 1989 when a feasibility study concluded that the deposit was sub-economic. In 1996, Randgold Resources acquired BHP Minerals Mali Inc.'s 51% interest in the project. In 2001, the company acquired an additional 29% interest in the project from Normandy La Source SAS, which increased its interest to 80%. A feasibility study was completed in 2003, and the board of Randgold Resources approved the development of the mine. The mine was scheduled to go into production in 2005 and was expected to produce an average of about 6,200 kg/yr of gold (Randgold Resources Ltd., 2004, p. 23-24).

Resolute Mining Limited of Australia entered into a 12-month option agreement with Randgold Resources to acquire an 80% interest in the inactive Syama gold mine at a cost of $6 million, including liabilities of up to $7 million and rehabilitation costs estimated to be $2.6 million. In addition, Resolute will pay $10 per troy ounce on the first 31,000 kg of gold (reported as 1 million troy ounces) produced and $5 per troy ounce for additional production up to about 120,000 kg of gold (reported as 4 million troy ounces) subject to the average quarterly gold price above $350 per troy ounce. Syama was owned by Société des Mines de Syama S.A. (80%) and the Government of Mali (20%). The Syama project, which is located in southern Mali about 30 km from the Cote d'Ivoire border and about 300 km southeast of Bamako, comprised three mining leases in a 200-km^2 area. The project was acquired by Randgold Resources in 1996 but operations were suspended in 2001 following a drop in gold prices. Gold ore was mined using open-cut methods. The ore was processed using a roaster and carbon-in-leach plant. A total of about 47,000 kg of gold (reported as 1.5 million troy ounces) had been produced at Syama at the time of the closing of the mine. Total measured, inferred, and indicated resources were estimated to be about 50.6 Mt at a grade of 3.2 g/t gold or about 160,000 kg (reported as 5 million troy ounces) (Africa Mining Intelligence, 2003; Mining Journal, 2003; Resolute Mining Limited, 2003).

Exploration at the Diagounte property, which is located about 30 km southwest of the Sadiola Mine in western Mali, was conducted by Robex Resources Inc. of Canada (RRI), which held an 85% interest in the project. RRI began its Malian exploration campaign in 1996. In August 2003, the company searched for a partner to raise $9 million to fund its exploration and development program at Diagounte, which would include the construction and commissioning of a mine at the site. In November, RRI announced that it had acquired three new properties in the Kenieba Valley. The acquisition consisted of an exploration permit for Dabiya West, a prospecting license for the Kolomba property, and an exploration permit for the Kossaya property. In December, the company signed an agreement with RMB Resources Limited of the United Kingdom whereby RMB agreed to negotiate on behalf of RRI the terms of a $6 million loan for the development of the La Corne deposit, which was an eluvial surface placer within the Diagounte property. The company announced an indicated resource at La Corne of 1.78 million cubic meters of eluvial soil that contained an average grade of 3.22 grams per cubic meter of gold or a total of 5,740 kg of gold (reported as 184,553 troy ounces) (African Mining, 2003b; Robex Resources Inc., 2003a, b).

Sanu Resources Ltd. held a 3-year exploration permit for the Makono gold property. The property is located on the east bank of the Niger River approximately 60 km southwest of Bamako and covered an area of 90 km^2. The permit was acquired in August 2000 and was renewed in September 2003. Previous works included soil geochemistry and pitting. At yearend, Sanu Resources was looking for a joint-venture partner to develop the property (Sanu Resources Ltd., 2004§).

Intermittent diamond exploration programs have been conducted in Mali since 1954 following the discovery of a 137.5-carat diamond on the Doundi River. Other alluvial diamond occurrences have been reported since 1954, including the discovery of a cluster of diamonds that ranged from 50 to 232 carats at Sansanto in the Doundi Valley. A total of 29 kimberlite pipes and dikes were identified within a radius of 25 km from Sansanto (African Metals Corporation, 2003a§).

AMC held the Kenieba Nord and Kenieba Sud diamond concessions in western Mali. The total area covered by the concessions was 3,415 km^2 and hosted 16 known kimberlites and an area of alluvium where diamond had been discovered previously. In September 2003, AMC was granted an exploration permit for the concessions and announced the start of its first exploration program at Kenieba Sud. The company planned to dig 10 test pits near the area where the 232-carat diamond was found and in the proximity of the area where the Sansanto diamonds were discovered. Other pits were to be dug between the two sites during the year (African Metals Corporation, 2003a-d, 2003a§; African Mining, 2003a).

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TABLE 1
MALI: PRODUCTION OF MINERAL COMMODITIES[1, 2]

(Metric tons unless otherwise specified)

Commodity		1999	2000	2001	2002	2003[e]
Gold, mine output, gold content[3]	kilograms	23,690	28,717	42,288	56,043 [r]	45,535 [4]
Gypsum[e]		500	500	500	500	500
Salt[e]		6,000	6,000	6,000	6,000	6,000

[e]Estimated; estimated data are rounded to no more than three significant digits. [r]Revised.

[1]Table includes data available through October 25, 2004.

[2]In addition to the commodities listed, Mali produced clays, stone, and sand and gravel for local construction purposes, and diamond and phosphate rock, but information is inadequate to make reliable estimates of output levels.

[3]Does not include gold produced by artisanal methods, which has been estimated to be about 2,000 kilograms per year.

[4]Reported figure.